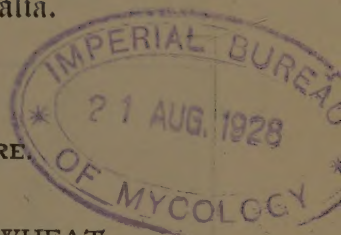


Western



Australia.

DEPARTMENT OF AGRICULTURE.



ROOT-ROT AND FOOT-ROT OF WHEAT.

(*Wojnowicia graminis* and *Helminthosporium sativum*.)

W. M. CARNE, F.L.S.,

Economic Botanist and Plant Pathologist.

There are several diseases of wheat in Australia characterised by the rotting of the roots and bases of the stems. Of these the best known to growers is Take-all, the name applied to the disease caused by the fungus *Ophiobolus graminis*. This article is intended to draw attention to two diseases somewhat resembling Take-all, and often confused with it. One of these is due to *Helminthosporium sativum*, which causes the condition known as Foot-rot, and the other to *Wojnowicia graminis*, which also causes a foot-rot, but for which the term Root-rot is suggested. It must be understood at once that all three fungi cause a root or foot-rot disease, and the terms used are simply for convenient distinction.

Though the casual fungi are themselves quite distinct, the same cannot always be said for the symptoms of wheat plants affected by them. The following distinctions hold good in normal cases, though it must be admitted that a laboratory examination is sometimes necessary for positive identification.

Take-all (Cause = *Ophiobolus graminis*).—Attacks usually in more or less rounded patches of varying size. May kill seedlings or half-grown plants, or cause "whiteheads," that is, prematurely ripe heads without grain. The stem bases show a black discoloration, extending above the ground level and covering a length of stem upwards of two inches. This discoloration is partially superficial, and a black felt of fungal growth can be scraped off the stem or the inner surfaces of the leaf bases surrounding it.

Root-rot (Cause = *Wojnowicia graminis*).—Though this parasite may attack wheat in patches, these patches are more irregular than in Take-all, sometimes appearing as strips. In more typical cases affected plants are scattered through the crop, and this also occurs even when some of the affected plants are in patches. Both Root-rot and Take-all may occur together, which makes field identification more difficult. Though plants may be killed as seedlings or before heading, Root-rot is usually not noticed until "whiteheads" begin to show up in a crop. If grain is formed, it is usually shrivelled. The stem discoloration is less marked than in Take-all, and rarely extends above ground. It varies from dark brown to black in colour and is partially superficial, so that it may be mistaken for Take-all. The discoloration is, however, usually in spots and streaks rather than generally distributed over the surface as in the latter disease.



Wheat affected by Root Rot, showing effects on roots and stem bases.

Foot-rot (Cause = *Helminthosporium sativum*).—This disease is similar to Root-rot in its field occurrence, and usually is first noticed when “whiteheads” appear in the crop. The stem discoloration takes the form of dark brown streaks, spots or patches. There is no superficial black fungal growth, and the affected parts of the stems do not extend above ground. Grain, if formed, is usually shrivelled.



Foot Rot of Wheat, showing stages of development in infected plants.

(Photo. Department of Agriculture, N.S.W.)

Of the three diseases Take-all and Root-rot are about equally common in this State. Foot-rot is relatively rare. During the recent season (1927) Root-rot was apparently more common than Take-all. Many crops in the eastern, central, and southern areas, which promised well up to the end of September, then showed evidence of disease in the form of “whiteheads.”

In some cases losses of 30 to 50 per cent., and occasionally even more, of the estimated yield were experienced. Ten per cent. losses were not uncommon, while other affected crops were cut for hay.

Assuming Take-all, Root-rot, or Foot-rot to be present in crops, the amount of damage done is determined by the climatic conditions. For serious loss there must be the combination of one or more of these fungi, sufficient soil moisture and a suitable soil temperature while the crops are still green. Experiments at Wisconsin, U.S.A., have shown that infection by Take-all is greatest at soil temperatures of 54 deg. to 64 deg. Fah., while with Foot-rot maximum infection takes place at 80 deg. to 90 deg. Fah. Concerning Root-rot no experimental data is known to the writer, but its occurrence at the same time as Take-all, and not infrequently on the same plants, indicates that its temperature requirements must approximate to those of Take-all.

Accepting the foregoing we can see that Foot-rot damage is liable to occur seriously on crops (where the disease is present) only when the temperatures are high and the ground moist. Such conditions might occur with April rains in early-sown crops or with hot spells in the spring and early summer. In the latter case there may be insufficient moisture for the fungus to thrive.

Take-all and Root-rot on the other hand require a medium soil temperature. They may therefore be expected about June before the soil gets too cold or in the spring. The longer the period of medium soil temperatures the more likely are these fungi to spread and cause serious damage. The 1927 season, following the warm dry spell, which concluded on 12th September, was notable for the continued humid weather, dull skies and showers, and an absence of dry easterly winds until about the middle of November. The temperatures were moderate, and the consequent widespread appearance of Take-all and Root-rot when the plants headed was in accordance with expectations. Along the Eastern Goldfields line and southward these diseases were in evidence, and especially in the southern and eastern portions of the Great Southern line. There the temperatures were particularly mild and favourable for infection.

It is noteworthy that the humid conditions of the season caused the appearance of rust throughout the wheat belt, though without causing serious loss, except in individual crops in the Midland areas. Take-all and Root-rot were not reported from the northern areas, the higher temperatures, though favourable for rust, apparently operating against root diseases. A somewhat similar distribution of these diseases occurred in 1926, which was also a season of late rains.

The conclusion to be arrived at from the foregoing is that late rains in the spring and early summer, combined with cloudy, humid weather, are liable to lead to rust more particularly in the northern areas and to root-rotting diseases in the central and southern wheat areas. Humidity must not be judged on a basis of rainfall. Heavy rain storms followed by bright warm weather and easterly winds are less favourable to these diseases than cloudy showery weather with westerly winds, though the actual seasonal rainfall may not be above normal.

Infection in Foot-rot and Root-rot takes place from the soil. The soil itself becomes infected through the presence of infected plants or through the infected stubble of wheat or susceptible grasses being blown or carried

on to the paddocks from infected stubble land or headlands. Barley, Barley Grass (*Hordeum murinum*), and the so-called Spear Grasses (*Bromus spp.*) are liable to these diseases. Oats are not known to be attacked, and the same applies to field peas and other crops not belonging to the Grass family. Root-rot infection is not carried by the seed. *Helminthosporium* may sometimes attack the seed, causing a discoloration at the germ end, called "black-point." Such a discolored sample of grain should not be used for seed. Blackpoint is not, however, positive evidence of Foot-rot, as other fungi may cause similar discoloration.

Control Measures on infected land.—These measures are identical with those advocated for Take-all. It must be realised that control is all that is practically possible. Eradication cannot be expected. By following the practices advocated the diseases will be reduced to a point where they do a minimum of damage, though it must be admitted that that minimum may be appreciable in years favourable for infection. It is not expected that all farmers will be able to carry out the recommendations as thoroughly as one would like. They are recommended as ideals at which the farmer should aim as far as his time, farm equipment and other circumstances will allow. At the same time, in so far as they are not carried out, the best results cannot be expected, nor should they be criticised on the results obtained when followed only in part.

1. *A good, clean, stubble burn in badly-affected paddocks.*—The object of this is to destroy as much as possible of the lower parts of the infected stems. These are the parts which carry the fungus. The latter does not die with the plants, but lives in spore (fungus seed) form in the dead wheat tissues. If not burnt the infected parts of the stubble will be blown about the paddock and into other paddocks, especially if broken up by the tramping of sheep. The headlands should also be burnt, as some of the common grasses carry diseases.

2. *Early and clean fallowing before sowing wheat.*—Unfortunately a stubble does not destroy all the affected stem bases or roots, and cannot be relied upon to effectively control these diseases. It is therefore necessary to plough the infected areas early so that the spores are turned into the moist soil. This will not cause them to rot, but will induce many to germinate. Once they have germinated they must find something to attack or die. Hence the necessity for clean fallows. If ploughed in July it is probable that in August or September the fallows, if not cultivated, will be green. This green growth will certainly include Barley Grass and Spear Grass. These grasses are subject to the diseases, and will be attacked by the spores already ploughed in. On them the fungi will revive and proceed to the production of more spores, destroying to a large extent the value of the stubble burning and early ploughing. Therefore the stubbles should be kept clean in the spring. From July to November in a cool, moist spring, or to October in more normal year it is dangerous for grasses to grow on infected fallows. After that, from a disease point of view, it matters little what growth occurs. At high temperatures, either or both the fungi and the susceptible grasses will not grow.

3. *Rotation with oats for grazing, hay or grain* will give another season for the spores in the soil to germinate and die. Oats are not affected by Root-rot or Foot-rot.

4. *Sowing wheat after the first rains*, when the season allows, gives such fungus spores as still remain in the soil a further chance to germinate and die before the wheat germinates.

When all the above practices have been carried out to the best of the farmer's ability, he must not forget that Barley Grass and Spear Grass along the headlands and in adjoining paddocks left in grass are potential sources of infection to clean paddocks if growing on infected soil. To let an infected area go to grass does not check the disease on that area. Rather it is liable to infect adjoining areas through infected fragments of the grasses being blown or carried to them.

Summary.—Root-rot and Foot-rot are diseases of wheat resembling Take-all.

They can generally be distinguished from Take-all by not occurring in rounded patches, and are usually first detected through the appearance of "whiteheads" in the crops.

Root-rot is probably as common as Take-all in this State. Foot-rot is relatively uncommon. Though found in all seasons their serious occurrence is closely dependent on weather conditions.

The methods recommended for the control of Root-rot and Foot-rot are those which have proved successful with Take-all. Their most essential features are early and clean fallowing, and rotation with oats.

